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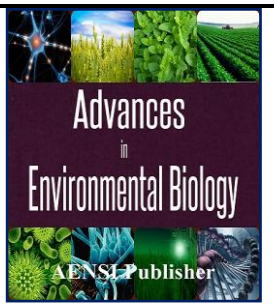

Evaluation of Land Use at Third Campus Development of UIN Maulana Malik Ibrahim Malang with Low Impact Development (LID) for Environment Sustainability

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ABSTRACT

Land use on The Third Campus development of UIN Maulana Malik Ibrahim Malang potentially pose some environmental threat, such as the impact of runoff. The development will be held on contoured and large farm land. this condition will affected the infiltration of rainwater. Therefore, the evaluation of the master plan of the third campus development using LID parameters to determine the optimal zone and types of LID recommendations.

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INTRODUCTION

UIN Malang have a plan to develop the third campus. To support this, it has been arranged master plan document with green and smart campus concept. This concept designed by existing conditions of the third campus development such as contoured land, at high altitude location with high rainfall and farm land dominance. Therefore, if not managed properly, the land use of The Third Campus development of UIN Maulana Malik Ibrahim Malang predicted to potentially pose some major threat. The potential environmental threats includes: reduced rainwater infiltration, flooding, erosion, and reduced groundwater sources.

The Third Campus development with green and smart campus concept also integrated the transportation system, open green space and buildings system, to support the environmental sustainability system. However, the green and smart campus development concept in master plan only considering normative and basic concept. there is no technical explanation to reach environmental sustainability.

Evaluation of land use on the third campus master plan using LID parameter to identify the optimal zones and the sub-optimal zones to anticipate the environmental impact of development that affected by surface runoff. This evaluation is expected to produce a broad area to LID aplication. Therefore, the aim of this study is to optimize land use in the third campus development to achieve sustainability and to anticipate environmental impact, especially in anticipation of the water runoff impact.

2.0 Literature Review:

LID is a measuring and parameters to evaluate land use of the third campus development of UIN Maulana Malik Ibrahim Malang . LID is planning and designing a comprehensive land use that aims to anticipate the environmental impact on the runoff catchment to achieve sustainable campus. LID is a strategy to design footprint with the purpose to maintain or to replicate hydrology before developed by using design techniques that makes more functional landscape, including integrated of microscale and distribution of stormwater management and detention area, reduction of surface, and for water flow and runoff.

The scale of techniques of LID system is divided into 4 scale, i.e.: local, intermediate, catchment, and reach. Local scale is used rain barrels, green roof, and porous pavement; intermediate scale is used rain garden and vegetated swale; catchment scale is used detention pond and retention pond; and reach scale is used riparian buffer for the LID application into the design (Mikle, Table 1 Common LID techniques grouped according to generalized site suitability

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The optimal location of local scale is located at drainage areas that contribute to the area hydrologically sensitive areas (HSAS), which intersect with the watershed. The optimal location of intermediate scale and catchment scale is identified by the incompatibility of the type of land cover and land use. While, the optimal location of reach scale is calculated from the index topography 30m from both sides of the river [3].

Methodology:

Study Area:

This study was conducted by evaluating the masterplan of the third campus developmentof UIN Maulana Malik Ibrahim Malang that located at Sumbersekar village, Junrejo village, and Tlekung village. Land area of the third campus is 110 hectares. According to the results of the feasilibility study, acquired 59.03 hectares or 53.67% of the total area that can be developed. The rest area is a contour land with a level of more than 15% slope.

Table 1:

LID type	Land use characteristics	Scale of technique	Effective in impervious areas
Rain barrel	Ideal for collecting rooftop runoff	Local	Yes, ideally suited
Green roof	Ideal for collecting rooftop runoff	Local	Yes, ideally suited
Porous pavement	Ideal for highly developed areas: parking lots, driveways and low-volume roads	Local	Yes, intended to replace impervious surface
Rain garden	Ideal for collecting rooftop runoff and runoff from yards and sidewalks. Also good for collecting runoff from roads and small parking lots	Intermediate	Intercepts runoff from impervious areas but requires land for construction
Vegetated swale	Ideal for collecting sheet flow runoff from roads and highways. Also ideal for collecting runoff from subdivisions	Intermediate	Intercepts runoff from impervious areas but requires land for construction
Detention pond	Ideal for detaining runoff from large catchment areas (i.e., as large as 75 acres)	Catchment	Intercepts runoff from impervious surfaces but requires large piece of land for construction
Retention pond	Ideal for retaining water from parking lots and residential areas	Catchment	Intercepts runoff from impervious surfaces but requires large piece of land for construction
Riparian buffer	Ideal for land directly adjacent to streams and rivers	Reach	Intercepts runoff from impervious surfaces but requires large land adjacent to stream for implementation

Sources: Muthukrishman, S.,2004 dalam Mikle, Chelsea J. Martin, de Beurs, Kirsten M., Julian, Jason P., dan Mayer, Paul M., 2015

Table 2: Land Use and Land Cover Data Used to Determine Suitable LID Sites.

Scale of LID	Roads	Building footprints	Flood plain	Stream buffer zone	Existing ponds	Land cover
Local	Yes	Yes	Yes	Yes	No	All categories of land that include some impervious surface
Intermediate	No	No	No	No	Yes	Water (ponds only), partial impervious areas,soil/barren,grass/herbaceous/ agriculture
Catchment	No	No	No	No	Yes	Water (ponds only),partial impervious areas,soil/barren,grass/herbaceous/ agriculture
Reach	No	No	Yes	Yes	No	Partial impervious areas, soil/barren, grass/herbaceous/agriculture, trees/forest

Sources: [3].

RESULTS AND DISCUSSION

Existing conditions of the third campus development land is contured and farm land. The land countour of this development is ranging from +745 to +915 asl (above sea level) and undulating with following the decline in small streams on East side. According to the masterplan development, land use of the third campus development is divided into 4 segments of development zones, they are:

1. Commercials and services block, worship block, and green space block
2. Learning block, rector and administration block, and open space block
3. Teaching hospital area, sports area, conservation area, and dormitory area
4. Conservation area and supporting campus area

Here is a land use plan on the third campus development:

The third campus development makes land use changing from empty fields and contoured into educational facilities. According to the third campus masterplan, land use changing also affect to the landcover types, that include to: building, green space, pavement (circulation path), and blue space. Building as one the landcover types on the third campus development has a void shape and kubuisme forms. Moreover, it also has the roof shape with combination of sloping roofs and flats roofs. Building as the main support on the learning facilities

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of the third campus development has a minimum width of 20 m to adjust with learning and adinistrative activity needs.

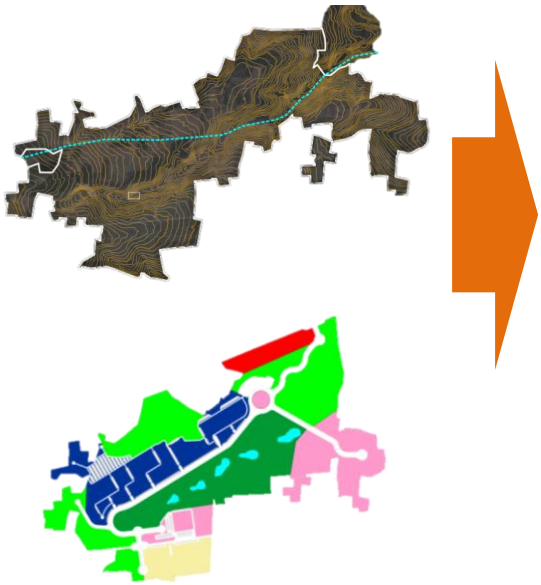

Fig. 1: Existing Conditions and Land Use Plan of The Third Campus of UIN Maulana Malik Ibrahim MalangAccording to zoning in **Figure 1**, land use plan of the third campus development shows that the red zone as the commercials and services area; the blue zone as learning area; the dark green zone as conservation area; the light green zone as green space; the pink zone as public service area; the light brown zone as residential area (dormitory); and the aqua zone as lake area (blue space). According to the masterplan, the division of the land use block in the third campus development is as follows:

Fig. 2: The Masterplan of The Third Campus of UIN Maulana Malik Ibrahim Malang.

Fig. 3: Building Forms on The Third Campus Development source: [2].

Pavements as landcover for pedestrian ways, main circulation, parking area, and several plaza is used aspalt and paving. The aim of aspalt and paving in the circulation path is to provide user comfort. The main circulation connects between building blocks consist to 2 lanes of vehicles, cycling trails, and pedestrian ways. While the parking area on the masterplan of the third campus development is located around the building that

adapts to covering the user needs. Therefore, the pavement on the circulation path, the pockets of parking, and the plaza have an impact on the increasing area covered pavement and buildings so that reduced the rain water infiltration land.

Green space and blue space as landcover on the third campus development will be provide vegetation area, park area, green corridor, and artificial lake. The function of vegetation in the green space area, especially in the conservation zones are as retaining the contoured land and absorbing rainwater. Moreover, the vegetation also serves as a shade and sterrring. While the artificial lake in the green space and blue space is located around

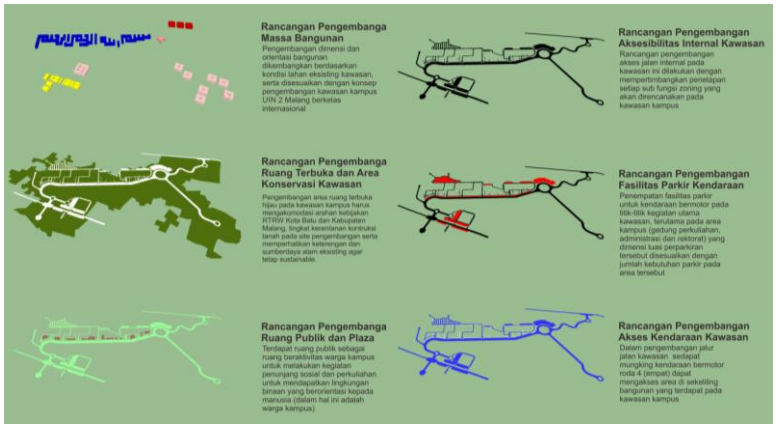

Fig. 4: The Planning of The Third Campus Development of UIN Maulana Malik Ibrahim Malang source: [2].

The changes of landcover types, based on the land use of the third campus development resulted the less land for water catchment, especially building and pavement type. Narrowing of the infiltration land will be causing erosion, flooding, landslides, and reduced groundwater supply. Therefore, to optimize and to increase infiltration land is done by zones evaluation with LID and resulting recommendations of LID zone and LID type.

Identification of the LID type use based on Table 1 and Table 2 is done by classifying of landcover and land use types on the third campus masterplan. The results of this classification are landcover types, scale of technique and LID types that suitable for solutions of runoff problem on the third campus development.

On the buildings landcover type, the suitable of LID types is rain barrels and green roof with local scale. It was the handling or runoff in the building can be done by capturing rainwater dan distributing it into cistern to store of rainwater. While the green roof area, the water is absorbed by the soil before distributed into the cistern. However, the rain barrels are more effective and efficient than green roof to distribute of rainwater. Therefore, the rain barrels has a larger percentage than the green roof.

The comparison between use LID and design of the third campus on building as landcover type, include to: on the design of the third campus runoff is directly channeled into the secondary channel footprint and then flowed into the channel of the city, while the design with LID type, runoff is collected and absorbed into the ground to increase the source water supply. Therefore, by using LID in the buildings more effectively to achieve sustainability.

On the green space and blue space, the suitable LID type is riparian buffers, vegetated swale, and a rain garden. On the blue space, the riparian buffer serves to protect the springs and contoured areas, while the vegetated swale utilize contoured area that serves to hold the soil. On the green space, the rain garden performed to filter water runoff originating from pavement and buildings. Moreover, the rain garden is also influenced by the location part of green space were close to the pavement and buildings. The existence of LID type setting on green space and blue space will establish certain themes in both landscape as a whole functions as retaining surface water runoff.

On the pavement types, the parking area and pedestrian ways is used porous pavement to infiltration runoff. The porous pavement is more effective than using a solid block paving for sustainability. While the main circulation path is used asphalt pavement. The anticipation of runoff is done by providing a slope on the outer side with following the contour. Moreover, at some point given the sewers to reduce pockets of water in the circulation path.

According to the identification and classification above, the following is conclusions of the scenario of LID type on the Table 3 Scenario of LID Type on Development Zones of The Third Campus of UIN Maulana Malik Ibrahim Malang

Table 3:

Zone of Development		Scale of technique	LID Type	Scenario of LID Procentase (%)	Areas (Ha)
1	Commercials and Services Area				
	Building block	Local	Rain Barrel/ Cistern	75	2,44
			Green roof	25	
	Parking Area	Local	Porous pavement	100	
2	Islamic Center and Main Plasa Area				
	Islamic Center Building (Mousque)	Local	Rain Barrel	100	3,15
	Main Plasa	Intermediate	Rain garden	100	
3	Learning Area				
	Learning building	Local	Rain Barrel	75	37,63
			Green roof	25	
	Plasa	Local	Porous pavement	100	
	Local parking area	Local	Porous pavement	100	
4	Main Parking Area				
	Car parking area	Local	Porous pavement	100	
	Motorcycle parking area	Local	Porous pavement	100	
5	Building Development Area				
	Building block	Local	Rain Barrel	80	23,54
			Green roof	20	
	Local parking area	Local	Porous pavement	100	
6	Conservation Area	Reach	Riparian buffer	30	24,02
		Intermediate	Vegetated swale	70	
7	Green Space	Reach	Riparian buffer	10	7.58
		Intermediate	Vegetated swale	50	
		Intermediate	Rain garden	40	
8	Teaching Hospital Area				
	Building Block	Local	Rain Barrel	75	3,99
			Green roof	25	
	Local parking area	Local	Porous pavement	100	
9	Dormitory Area				
	Building Block	Local	Rain barrel	75	7,41
			Green roof	25	
	Local parking area	Local	Porous pavement	100	
10	Sport Area				
	Yard	Intermediate	Rain garden	100	3,57
	Local parking area	Local	Porous pavement	100	
11	Circulation Path				
	Main circulation	-	-	-	
	Pedestrian ways	Local	Porous pavement	100	

Sources: Analysis, 2015

5.0 *Conclusion:*

The conclusion of this study, the paramater LID can be used as one of the evaluation techniques to obtain the maximum sustainable concept. Through LID, sustainability level of the third campus of UIN Maulana Malik Ibrahim Malang Masterplan reached around 70-80%. The attention in determining of the LID type is the landcover type so the LID type on the changes of landcover can anticipate the runoff impact effectively to achieve sustainability as a result of land use changes in the third campus of UIN Maulana Malik Ibrahim Malang Development.

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